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ASTRONOMERS DISCOVER MERCURY TWIRLS RAPIDLY

By Isabel M. Lewis,
of U.S. Naval Observatory.

Observations of the planets made at the Mt.Wilson Observatory during the past year have led to the surprising conclusion that Mercury, the smallest of the planets and the one nearest the sun, turns on its axis rapidly and not in a period of 88 days, equal to that of its revolution around the sun, as has long been believed.

It was found from measurements of spectrograms of Venus, however, that this sister planet of the earth rotates slowly in a period that cannot be less than twenty days. The results for Venus are in accord with the results of a similar investigation made some time ago by Dr. E. C. Slipher of the Lowell Observatory.

Comparisons were made of the radiations from the surfaces of Mercury and the moon and it was found that the temperature of the illuminated side of Mercury is about equal to that of the moon. This is an unexpected result. Mercury is much nearer than the moon to the sun and if it always kept the same side turned toward the sun, as it would if its rotation period were 88 days, then the radiations from its illuminated surface should be much more intense than the radiations from the surface of the moon. The best explanation of the observations seemed to be that the planet is rotating in a short period. Observations of the radiations from the dark side of the planet also supported this view. Radiation from the surfaces of the moon and Mercury were found to be very high, about 74 per cent. in each case, and this furnished new evidence that these bodies have little if any atmosphere.

Even with a short period of rotation life on Mercury would be an impossibility owing to the absence of any appreciable atmosphere. On Venus even with a long rotation period life may exist for the atmosphere of Venus is as dense as that of the earth, if not denser. Seasonal changes on Venus would be lacking because the axis of rotation of the planet is perpendicular to its orbit. The temperature at any one point on the planet's surface would be uniform throughout the year, intensely hot in equatorial regions, frigid in polar regions, though air currents would do much toward equalizing the extremes of heat and cold.

Mercury is the least observed of the brighter planets. As a result of its nearness to the sun it is lost in its rays most of the time and can only be seen for two weeks or less near the time of its greatest elongation from the

sun, and even then it cannot be seen to advantage in high latitudes when the ecliptic makes a small angle with the horizon. It is best seen in the evening in March or April, and in appearance is very similar to the bright star Vega.

Venus has been a brilliant Evening Star in the west for a number of weeks and will continue to be the most conspicuous stellar object in the western evening sky until early in the summer. It is approaching the earth at the rate of about half a million miles a day and is increasing in brightness. On February 15 its distance from the earth was about 110,000,000 miles. Viewed through the telescope it resembles the moon between the first quarter and full. When it reaches its greatest elongation east of the sun on April 21 it will resemble the moon at first quarter and after that date it will gradually assume the crescent form. A month later it will attain its greatest brilliancy while still in the crescent phase and a few weeks later will come into inferior conjunction with the sun and disappear from the western sky, to reappear a few weeks later in the east before sunrise.

READING REFERENCE - Gregory, Sir Richard. The Vault of Heaven; an Introduction to Modern Astronomy. New York, E.P. Dutton & Co., 1923.

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LIGHT MAY BE A SERIES OF TINY DARTS OF ENERGY

What we know as light is not a series of spreading waves in the ether that was supposed to fill all space, neither is it a rain of infinitesimal particles shot off from the light-giving body, as was once thought; but it is probably a rain of tiny darts of energy, acting in some ways like waves and in others like particles, Dr. W. P. Davey of the research department of the General Electric Company said in an address before the Franklin Institute in Philadelphia.

Each of the older theories explained some of the facts that were known about light, but not all of them, the speaker said. A study of the structure of some crystals made the theory that light was a rain of tiny particles extremely improbable. The old theory of waves spreading out from the source like those from a stone dropped in a pond, failed to explain why it is that when a ray of light falls on a clean metal surface, electrons of the metal try to jump out of it with the same velocity that the light rays strike it.

A combination of the two theories has been proposed by Dr. L. Silberstein of the laboratory of the Eastman Kodak Company, Dr. Davey said. He thinks of light waves as tiny search-light beams which he calls "darts". These are supposed to be electro-magnetic waves which do not spread out in all directions but which transmit the energy from the electron giving the light in beams of definite size which travel out in straight lines. The reason light appears to come from all directions is that there are so many electrons in a radiating body that they shoot out light "darts" in all directions.

Just how an electron gives out light nobody knows, Dr. Davey said. One

theory conceives of light being given out by the vibrations of electrons on the outside of atoms while vibrations of those on the inside cause X-ray radiation. The other theory conceives of an atom as a sort of whirling solar system of electrons revolving around the nucleus and that light results when an electron skids and slips from one sort of orbit into another. Both theories account for some of the observed facts.

READING REFERENCE - Fleming, J.A. Waves and Ripples in Water, Air and Ether. New York, Macmillan Company, 1923.

Lewis, Gilbert Newton. Valence and the Structure of Atoms and Molecules. New York, Chemical Catalog Co., 1923.

VOLCANIC STEAM RUNS FACTORIES IN ITALY

Volcanic steam as a source of power is now in commercial operation in Italy according to a report published here and based upon a paper read by Prince Ginori Conti at a recent meeting of the Italian Association for the Advancement of Science. The principal source of natural steam is in the Volterra region about 40 to 50 miles south-southwest of Florence.

The steam jets and hot water springs of this district which contains about two and a half square miles have been known for centuries, but power development there is relatively recent. Two 3000 kilowatt turbo-generators of the Parsons type are now delivering a three phase current at 4000 volts, which after transforming into higher voltages is carried to the neighboring cities of Florence, Leghorn, Sienna, and Piombino.

The natural steam is obtained from iron encased bore-holes, 16 inches in diameter and from 200 to 500 feet deep. It issues at an average pressure of two atmospheres and a temperature varying from 100 to 190 degrees Centigrade, friction against the walls of the bore causing much of the heat. Recent borings have released steam at a considerably higher pressure and in quantities up to 59 tons an hour.

The steam contains an average of six hundredths of one per cent. of boric acid, which by the latest process is recovered. Four to six per cent. of gases are also found in the steam, these impurities being over 90 per cent. carbon dioxide with small percentages of hydrogen, helium, hydrogen sulphide, argon, oxygen, nitrogen, and ammonia.

In the latest method described by Prince Conti, who has been most active in the industrial development of this region, all these impurities are separated from the natural steam which is then fed directly into the turbines. Earlier methods were the direct use of the steam in reciprocating engines, and the use of steam derived from the boiling of condensed water from the natural steam. This was boiled by the superheated natural steam and used in turbines in place of the natural product so as to eliminate corrosion of the turbine blades from the impurities.

Boric acid of high purity is recovered by evaporating the condensed natural

steam in shallow lead pans, the heat being supplied by the uncondensed steam. When a concentration of about eight per cent. is obtained the boric acid is crystallized out on cooling and is subsequently purified by recrystallization. Ten tons of ammonium carbonate a day are produced from the ammonia recovered in the steam at the works at Castelnuovo.

READING REFERENCE - Bonney, T.G. Volcanoes, their structure and significance. New York, G.P. Putnam's Sons, 1899.

SIMPLE SCIENCE

By WOW

(WOW is a professor of chemistry in a large University)

SULPHUR

There are two kinds of odors - smells and perfumes. Then again a man often gets a reputation from the company he keeps. Sulphur hangs around with smells, so it has a bad character. Chemists carry round smells with them too. That's why they're so unpopular.

Likewise most men are all right when single, but not when married. Elderly girls vice versa. Sulphur doesn't smell when it's alone, but as soon as it joins up with something to form a gas it's terrible, for example, when it burns, likewise in sulphur water, and bad eggs. It's easy to understand why men are so different when married, but it's hard to understand why sulphur does it. Chemists think they know a lot, but they can't explain this. Nobody knows.

We all know sulphur because our mothers were strong on it. When we weren't breathing in sulphur fumes for sore throat, etc., we had to eat it with molasses for some other ill. An ill is the same as sick.

Sulphur is found in Sicily and Louisiana. When they find it in Louisiana it's away down in the earth. So they send down some steam through a hole. This melts the sulphur, and then they send down some air, and the melted sulphur shoots up another hole, much like a ferret chases out a rabbit. In Sicily it comes from volcanoes.

Sulphur used to be used in matches - the eight day kind. People got tired waiting for these, so the matchmakers began to leave out the sulphur. Nowadays they use it for vulcanizing rubber and making gunpowder and sulphuric acid. These are all very useful things. Likewise sulphur is good for killing the bugs on trees, so they put it in sprays. Some people say we will get lots of sulphur fumes after we die, if we don't watch out.

An invention makes possible the removal of dirt and grease from wool without use of a liquid solvent.

SUN'S AGE AT LEAST TWO BILLION YEARS

The age of the sun has been fixed at something between two billion and three billion years by Prof. Walter Nernst after researches announced at a meeting of the Society for Industrial Progress. The estimates are based in part on the rate of decomposition of radio-active elements, and in part on deduction from Einstein's theory of relativity concerning the relation between mass and energy.

Early estimates set the age of the sun as low as 10 million years, but geologists showed this was too short to allow for the erosion and other changes observed in the crust of the earth since it became solid. The radioactive decomposition of uranium to lead is a more accurate cosmic clock and this indicates that the solid crust of the earth has existed for at least one and a half billion years. According to Nernst, the sun while getting past middle age is still good for 400 million years, after which a crust will form on its surface and life such as we know it will cease upon the earth.

READING REFERENCE - Einstein, Albert. Relativity, New York, Henry Holt and Company, 1920.

Russell, Bertrand. The A.B.C. of Atoms. New York, E.R. Dutton and Company, 1923.

AUTO RATTLE EXPERTS NOW RADIO FANS

How to deliver radio music and speech to the consumer with life-like perfection was called one of the greatest problems in radio by W. H. Martin of the American Telephone and Telegraph Company, and H. Fletcher of the Western Electric Company, in an address before the American Institute of Electrical Engineers.

The man who could identify each make of automobile by its rattle has become the radio fan who can spot radio stations by their peculiar noises while transmitting, they said.

But quality of transmission is by no means entirely up to the broadcasting station to solve, the two engineers declared, although they did not entirely shift responsibility from the broadcasting station.

"Before a radio listener can pick up any program from the ether he must be equipped with a receiving set, preferably supplemented with a loud speaker and amplifier," they said. "In general, between the broadcasting station and our ears there are these three intermediate pieces of electrical equipment; the receiving set with its means of tuning and detecting, an amplifier which magnifies the output of the detector, and a loud speaker which converts the electrical output of the amplifier back into sound waves which ought to be an exact copy of the performer's effort.

"At the present time measurements show that the quality of the important

broadcasting stations is far superior to that of the average receiving set. Careful measurements made upon WEAF, one of the country's foremost stations, shows that in the matter of quality it is practically ideal, such lack of faithfulness as is present being a variation in the loudness of reproduction. Deviation from perfect reproduction is so slight as to be unnoticeable even to the trained ear.

"Both music and speech consist of complicated collections of sound waves. The notes of music range all the way from the lowest tones of the organ and the kettle drum, which are in the neighborhood of sixteen vibrations per second, up to the high overtones of the violin and the piccolo which may extend even above 10,000 vibrations per second. The sounds of speech, although appearing very complicated to the ear, do not cover quite as wide a range of frequencies as those occurring in music. The exact nature of the sounds of speech has been carefully studied in the Bell System laboratories with results which may be summarized as follows. In general, most of the energy of speech is carried by the vowel sounds and at frequencies below 1000 vibrations per second, but the fine modulations of the vowels which produce the stop consonants involve frequencies mostly above 1000 vibrations or cycles. The production of the fricative consonants also involves higher frequencies, and it was found that such sounds as 's', 'f', and 'th' have their sound spectra in the frequency range between 4000 and 10,000 cycles.

"It is not necessary to transmit anything like such a broad band of frequencies in order to make speech intelligible. A transmitting system, be it either wire or radio, which carries a frequency range from 500 to 2000 cycles reproduces speech which can be easily understood, although it leaves much to be desired from the standpoint of naturalness. Results can be obtained for speech which are good as regards intelligibility and fairly good as regards naturalness with a frequency range from 100 to 3000 cycles. Appreciable improvement is obtained by the extension of the upper end of the range to 4000 cycles, and preferably it should be placed much higher.

"As regards music, the broad sweep of its frequencies from about 16 cycles to 10,000 cycles makes its proper handling in a broadcasting system extremely difficult, particularly when the large energy of some of the low notes such as used in the pipe organ are taken into account. However, it has been found that by transmitting a frequency range from 50 to 5000 cycles good reproduction of most kinds of music can be given.

"The volume of sound which must be handled in the case of certain musical instruments requires constant attention. For speech, the variation in average power is of the order of 1000 to 1. In music, and especially that such as is given by a symphony orchestra, the energy variation between the softest and the loudest passages may be as great as 100,000 to 1. In the present state of the electrical art, it is not practicable to handle such an enormous range of volume in broadcasting. This limitation arises, not so much from the capacity of the broadcasting apparatus as from the existence of extraneous noise. The softest musical passages when broadcast, must be made sufficiently loud to override static and other electrical interference in the ether, receiving set noise, and any incidental noise. When the softest passages are made loud enough to overcome such extraneous interference, it would be extremely expensive to provide the equipment for making the loudest passages 100,000 times as loud.

"Consequently, good broadcasting requires a skilled listener and a mon-

itoring device at the point where the program is picked up. The function of this listener is to adjust the amplifier in the broadcasting system so that its output will take due account of changes in loudness in the program.

"The loud speaker is the weakest member of the receiving trio. One of the best loud speakers on the market is over 300 times as sensitive for frequencies in the neighborhood of 1000 cycles as it is for 500 cycles and for 4000 cycles, and below 300 cycles its sensitiveness drops off so rapidly as to lose the power pitches entirely for all practical purposes. If it were not true that the ear itself is only indifferently good as a judge of intensities and quality, such an imperfect loud speaker would be intolerable!"

DEAD FISH NOT ALWAYS AS DEAD AS THEY SEEM

A dead fish sometimes isn't. That is a conclusion derived from experiments conducted at the Atlantic Biological Station at St. Andrews, N.B., by Dr. S.W. Britton, on the degree of heat or cold a fish can withstand. They may be chilled to the extent that their hearts stop beating and the whole body stiff and numb, and then if the temperature be raised, soon be up and frisking about their business.

The experiments were performed on flounder, eel, cod, skate, etc., which were living normally in a tank of water having a temperature of about 65 degrees Fahrenheit. From this they were transferred to cooling or warming tanks, the temperature of the water being gradually lowered or raised. In the cooling tank the water began to freeze at about 29 degrees. In this the fish could survive for a short time. Regardless of whether the cooling was slow or sudden, they would gradually stiffen. The heart was the last organ to succumb. They were kept in the water in this condition for from one to several hours, after which they could be resuscitated by raising the temperature.

The opposite extreme was 80 degrees Fahrenheit. With the gradual increase of temperature the fish showed restlessness and excitability. At 75 degrees respiration became difficult, but if the water was kept at this point a gradual adjustment took place and the fish got along quite comfortably after a while. When increased, however, respiration ceased and the heart stopped beating. The fish could be revived by lowering the temperature of the water or transferring them to a cooler tank.

THE WEIGHT OF STEAM

Most people think of steam as something without appreciable weight simply because it is lighter than air. But as a matter of fact a molecule of steam weighs just as much as a molecule of the water from which it came. The difference is, that when water is turned into steam there are fewer molecules in any given space and consequently any given volume weighs less. Above a temperature of 39 degrees Fahrenheit, water gets lighter and lighter as it is heated. Steam, on the contrary, gets heavier and heavier if it is both heated and compressed for more molecules are crowded into a given space.

NEW INSTRUMENT LETS 75 LISTEN IN ON HEART-BEATS

A stethoscope, or hearing device, that will enable 75 physicians to listen coincidentally to the heart-beat or murmurs within the patient's chest is the invention of Drs. C. J. Gamble and D. E. Replogle of Philadelphia, reported to the American Medical Association.

The new instrument has been on trial for some time in the clinic of Dr. Richard Cabot of the Massachusetts General Hospital in Boston, who aided in determining when the reproduction of sounds had been sufficiently developed to permit satisfactory teaching. The essential part of the apparatus is an electrical amplifier, designed for three successive magnifications of the current changes produced in a very sensitive transmitter. Three element vacuum tubes used in radio receiving are the basis, and special wiring relays the electrical oscillations of increasing intensity from tube to tube without distortion.

In addition, special ear pieces and chest pieces are used, the latter enclosed in a brass case to exclude extraneous noises. At each seat in the room a double contact telephone jack is provided with which the student plugs in when he desires to listen. Attempts to use loud speakers in place of the multiple receivers have been disappointing, but as the former are perfected the extra wiring and apparatus for multiple receivers may be eliminated.

PARENTS BLAMED FOR CHILDRENS' TANTRUMS

That the well-known advice of "The Duchess" in "Alice in Wonderland",

"Speak gently to your little boy,
And beat him if he sneezes;
He only does it to annoy,
Because he knows it teases",

contains much sound advice as well as some unsound has long been suspected. Confirmation of this belief is now produced by the National Committee for Mental Hygiene.

Its report agrees with the theory of all but the second line of the verse; but it is emphatic in the statement that youngsters soon learn whether tantrums are profitable or otherwise. If they feel they can get something out of them they proceed to have them as occasion demands.

Other causes are stated to be fatigue resulting from overexciting the child by late hours, shopping tours, too much movies, or too much attention from adults. Lack of play is another cause. Parents cannot expect their children to restrain their tempers if they do not restrain their own, the report continues, and while advocating firmness in dealing with children, it deprecates any show of temper or resentment.

The cure of tantrums should be adapted to the individual child. If he does it "because he knows it teases", show him that there is nothing pleasant to be gained that way. If due to physical causes, such as fatigue or lack of

outdoor play, remove the cause. If the cause is in the parent, the job is the hardest of all, says the report, but it can be done.

METAL CHROMIUM INDISPENSABLE TO INDUSTRY

Chromium, a metal almost unknown 40 years ago, is now declared to be one of the indispensable elements in modern industry by Clifford B. Bellis in a report on the present uses of the metal published in Chemical and Metallurligcal Engineering. Stainless steel and high-speed steel are two of its many useful applications.

For chromium is a sociable sort of element. It is of little value alone, while as an alloy or companion of other metals it does indispensable work. Alloyed with iron it makes a steel that is both hard and tough, and so has made possible the development of many characteristically modern appliances.

It is estimated that without chromium high-speed steel tools, the works of the Ford company at Detroit would have to be seven times their present size, and it is certain that without the use of chrome steel in automobile engines, the motor car would be a very heavy and cumbersome contrivance. Airplanes such as we know them would be impossible.

Stainless steel is produced by alloying steel with about 15 per cent. of chromium; and rustproof iron contains about the same proportion although with a less amount of carbon.

Metallic chromium is now made in the electric furnace and has a number of useful applications. It has been found to have nearly the same co-efficient of expansion as platinum and so is being used to some extent as a substitute for the more expensive metal in work requiring the sealing of metal with glass. Malleable chromium wire is being made by plating a copper wire with chromium, drawing down, replating, and continuing the process until the interior copper core is of negligible cross-section.

TYPHOID FEVER RARE DISEASE IN BIG CITIES

Typhoid fever is becoming an almost unknown disease in many American cities, according to the twelfth annual survey by the Journal of the American Medical Association of deaths from that cause in cities of more than 100,000 population. Norfolk, Va., had the distinction of being the only city in that class without a single death from the disease last year. Providence, Hartford, New Bedford, and Yonkers, had only one or two deaths. The measures for the eradication of the disease are perfectly well known, the report says, and include "the general use of sewerage systems, filtration or chlorination of water supplies, pasteurization of milk, and wherever these are in effect, the control of typhoid carriers".

Four-tenths of one per cent. of carbon monoxide, contained in automobile exhaust gases, will kill an ordinary man in one hour.

TABLOID BOOK REVIEW

THE ATOM AND THE BOHR THEORY OF ITS STRUCTURE By H.A. Kramers and Helge Holst with a foreword by Sir Ernest Rutherford, Gyldendal, London.

This is an elementary presentation of the foremost theory of physics at the present time. Prof. Rutherford in his introduction says: "It is the object of this book to give the reader a glimpse of the fundamental conceptions of this theory, together with some of the most significant results it has attained. The first four chapters have been devoted to a general survey of those parts of physics and chemistry which have close connection with atomic theory. No attempt has been made at a mathematical development, and the physical meaning of such mathematical formulae as do occur has been clearly emphasized in the text".

WOLVERINES

Efforts are being made to establish a closed season on wolverines which are now facing extinction. Formerly found in all the northern forests, and in those of the Rocky Mountains and Sierra Nevada, they are now found only in California in the high levels of the Sierra Nevada. One practical argument in favor of the preservation of the animal is that wolverines prevent the spreading of animal diseases by eating the carcasses of their victims. Known sometimes as the "glutton", wolverines are mighty eaters but no hunters; feasting rather on what they can find. They have been known to drive mountain lions and bears away from carcasses on which they wished to feast.

CAMOUFLAGED FISH

Submarine color photography has given additional evidence for the theory that the gayly colored fishes of tropical reefs wear their gay colors so that they may more easily fade into their environment. They escape larger fish which prey upon them while at the same time becoming hard to be seen by the littler fish upon which they in turn feed. Photographs taken near the sea bottom in these shallow waters have shown the natural background of corals, sponges, sea-anemones and other marine growths to be brilliantly colored. The gaudy fish merely conform to their background, and their gay colors are another instance of natural camouflage.

Jack pine, a tree growing in the southern part of Maine, has been discovered growing on an island in Lobster Lake 30 miles farther north than it has ever been noted before.

Species of rhododendrons which produce absolutely black flowers were recently discovered by an American botanist in Tibet.
